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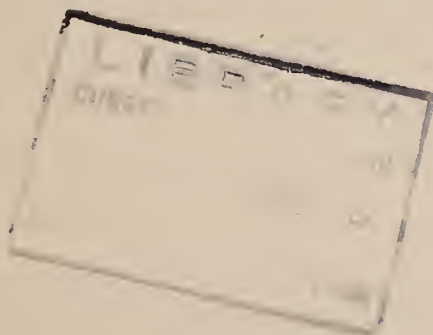
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AIC-270
(Supersedes AIC-239)

X
APPLICATION OF WAX TREATMENT TO BERRY BOXES
(HALLOCKS) TO CONTROL MOLDS X

Western Regional Research Laboratory, Albany, Calif.

In June, 1949, the Engineering and Development Division of the Western Regional Research Laboratory reported a successful treatment of berry-picking boxes in AIC-239, by E. J. Barta and E. Lowe. Growers used boxes treated by that method with success in 1949; meanwhile the Western Regional Research Laboratory extended the study to develop simple, practical equipment and specifications for equipment for the treatment of boxes. This report covers all phases of the investigation. E. Lowe and E. J. Barta have developed the wax dipping machine, and J. A. Mische and E. J. Barta have supplied the suggested construction specifications.



Bureau of Agricultural and Industrial Chemistry
Agricultural Research Administration
UNITED STATES DEPARTMENT OF AGRICULTURE

Application of Wax Treatment to Berry Boxes (Hallocks) to Control Molds

In recent years the problem of mold growth on berry boxes (commonly called hallocks) has become a serious one to both growers and processors in the Pacific Northwest. Sound berries, picked into fungus-infested boxes, frequently mold while being transported from the fields to the processing plants. The financial loss resulting from the loss of berries and the frequent replacement of condemned boxes is of serious concern to growers, packers, and, ultimately, to consumers.

This circular presents the results of experimental work conducted on the wax treatment of berry boxes to reduce mold growth. Recommendations are made regarding methods and procedures for wax coating new, air-dry boxes. Plans, specifications, and an explanation of operation for a semi-automatic dipping machine are also presented.

The treatment consists of dipping the boxes in molten wax, which penetrates the wood and effectively covers the surfaces with a film impervious to the fruit juices. This film also assists in the removal of infected organic matter when the boxes are washed prior to return to the fields. The treatment materially increases the useful life of the containers and reduces losses due to spoilage.

Type of Wax

A wax mixture consisting of 5 percent microcrystalline wax (melting point 160-165°F.) and 95 percent standard paraffin wax (melting point 143-150°F.) is very effective. This mixture produces a wax film which has excellent resistance to water or juice penetration, sufficient pliability to resist cracking or flaking, and a melting point far enough above normal field temperatures so that pick-up of field dirt is small.

Treating Conditions

General: The boxes should be air-dry and reasonably free of loose sawdust, wood fibers, and other foreign matter prior to the wax treatment.

Temperature: The temperature of the molten wax should be 15 to 20 degrees above the melting point of the wax mixture, or more specifically $160 \pm 2^\circ\text{F}$. Too low a temperature produces an excessively heavy film, resulting in higher coating costs, whereas at higher dipping temperatures the resulting film is too thin to serve as an effective water barrier.

Time: The time of dip should not be less than 15 seconds. With shorter times the stock has not heated sufficiently to allow adequate drainage of excess wax, and the elimination of trapped air bubbles is incomplete. No advantage is obtained from long dip times, since the amount of wax retained does not increase significantly after about 15 seconds.

Drainage and Cooling Time: After emergence from the molten wax, ample time should be allowed for drainage of excess wax and solidification of the adhering film. Under normal room temperatures of 60 to 75°F., the time required will not exceed 40 seconds.

Field Test for Determination of Wax Pickup

A simple test suffices for the determination of adequate wax pickup. For this test a drop of methylene blue solution (0.5 gram methylene blue in 1,000 cc. of distilled water) is placed upon the waxed surface, allowed to stand for 10 minutes, and then rinsed off with cold water. If no stain or one just barely visible to the naked eye is observed, the wax coat is adequate. A light but distinct blue stain indicates a wax coat which is not sufficiently resistant to water or juice penetration.

Dirt Pickup by Wax-Coated Boxes

Wax-coated boxes pick up field dirt to a greater degree at elevated atmospheric temperatures than untreated boxes do. On the basis of tests conducted at 100°F. it is estimated that the dirt pickup will be small. Such dirt is easily removed by gentle brushing or by a moderate water spray.

Estimated Material Costs

The following data will serve as a basis for estimations of material costs. Prices shown are those prevailing in the San Francisco Bay area, July, 1949.

Average wax pickup per box - - - - -	16 grams, or 0.6 ounce
Average wax pickup per 1000 boxes - - - - -	36 pounds
Cost standard refined wax (mp. 143-150°F.) -	9.8 cents per pound
Cost microcrystalline wax (mp. 160-165°F.) -	15.5 cents per pound
Total cost per 1000 boxes allowing	
5 percent for losses - - - - -	\$3.80

Equipment

Equipment for wax coating the boxes can be very simple. Wax dipping machines of various types are available commercially, and it is possible that some of them can be used or adapted for use. Care, of course, should be exercised in the use and handling of large quantities of inflammable materials such as paraffin wax. To minimize the fire hazard involved, electric immersion heaters or steam coils are to be preferred for heating the wax mixture. The following section describes a semi-automatic machine for wax coating berry hallowcks.

Operation of Wax Dipping Machine
(Single Dip Process)

The wax dipping machine shown on Drawing No. D-267 (attached) is designed to apply a uniform coating of wax to new air-dry berry boxes in accordance with procedures described previously. The device is designed to accommodate boxes 5-1/2 inches square by 2-1/2 inches deep, and consists essentially of (1) a melting tank in which solid make-up wax is liquefied, (2) a separate dipping tank with built-in steam coils or electric heating elements which maintain the molten wax at a controlled temperature, (3) a chute or chutes to guide the boxes through the wax bath, and (4) guide rails on which the coated boxes are retained long enough to allow the excess wax to drain and the adhering wax film to cool and harden.

In operation, boxes are introduced into the machine manually. Each box fed into the unit pushes the preceding ones through the dipping tank and on over the drainage rails. The coated boxes are removed manually.

Rate of Operation: The machine is designed to handle a maximum of 720 boxes per hour with a single chute through the dipping tank. This rate corresponds to a rate of one box every five seconds. The capacity can be doubled by installing two chutes through the dipping tank. In either case the boxes are immersed in the molten wax mixture for a period of twenty seconds, followed by a drainage and hardening period of forty seconds.

For optimum results, boxes must not be fed into the machine at a rate in excess of one per chute every five seconds. A faster rate of feed will result in imperfectly coated boxes and also an increase in wax consumption due to inadequate drainage of excess wax. At lower rates the correspondingly increased immersion and drainage times will not adversely affect either the character of the wax coating or the amount of wax used.

Procedure: The wax mixture recommended consists of 95 percent refined paraffin wax with a melting point of 143 to 150°F. and 5 percent microcrystalline wax with a melting point of 160 to 165°F. The solid waxes, in proportions necessary to make the recommended mixture, are placed in the melting tank located directly above the dipping tank. The waxes are melted and the mixture automatically maintained at the proper temperature by steam heating coils or electric heating elements located in the tank. The contents of the tank should be thoroughly stirred to insure uniformity of mixture, particularly after the addition of solid make-up wax.

The molten wax in the melting tank flows by gravity into the dipping tank below. Rate of flow is adjusted in accordance with demand by a hand throttle valve. A float-type indicator on the dipping tank provides visual indication of the liquid level in the tank. The level should be maintained at approximately 13 ± 1 inches, measured from the bottom of the tank. About 30 pounds of wax is required hourly for a production rate of 720 hallowcks per hour.

Heating Equipment: Either steam or electricity can be used to heat the wax in the melting and dipping tanks, the choice depending upon local conditions such as the availability and the relative costs. A schematic wiring diagram for electric heating and an isometric piping diagram for steam heating are shown on the drawing. Design steam pressure is 25 psig. Temperature control is automatic for either heating method. Separate controls are provided for the melting and dipping tanks. The wax in both tanks should be maintained at approximately $160 \pm 2^{\circ}\text{F}$. Heating capacity is adequate for either single or double chute operation.

Solid make-up wax must not be added directly to the dipping tank, because the heaters in the dipping tank are not large enough to supply the additional heat required to melt the wax. Also, because two kinds of wax are being mixed, the two must be melted and mixed before they are added to the dipping tank. The dipping tank should be drained free of all wax during shutdown, if the heat supply is turned off. Partially melted wax in the dipping tank will result in improperly coated hallocks.

Operators: Two operators are required to man the machine, one to place the inverted boxes on the feed rail and to push the train through the machine, and the other to remove the coated hallocks at the discharge end. For uninterrupted production at maximum capacity, a third operator will be required to deliver untreated hallocks to the machine, transfer the coated hallocks to storage, and to supply wax to the machine.

Suggested Construction Specifications

The melting and dipping tanks shall be constructed of 14-gage black iron sheet metal with spot-welded, riveted, or lock seams soldered water-tight, or welded seams fabricated by electric arc welding. The tanks shall be constructed absolutely water-tight. Before any insulation is applied, the tanks shall be tested for water-tightness by flooding with water. All leaks shall be made permanently tight before application of insulation.

Tanks shall be bolted, not welded, to the supporting frame.

The bottom and side walls of the two tanks shall be insulated with 1.5-inch-thick 85 percent magnesia, fastened to the metal sides with 1-inch, hexagonal-mesh, galvanized wire held in place by sheet-metal clips, and finished with a 0.25-inch-thick layer of insulating cement containing not less than 35 percent asbestos. The cement shall be applied in two coats to a total thickness of approximately 0.25 inch. All block joints shall be tightly butted together. A jacket of 6-ounce canvas shall be pasted over all insulated surfaces. The canvas shall be applied in a neat and workmanlike manner, with all raw edges pasted flush and smooth with the canvas jacket.

Apply one coat of oil-base primer and two coats of paint of a suitable color to all exterior surfaces, including iron work, sheet metal, and canvas jacket.

For Steam Heating: Steam heating coils shall be fabricated from Type L copper tubing with all joints silver brazed. Coils shall be tested for a working pressure of not less than 50 psig. Piping to and from the coils shall be standard-weight black iron.

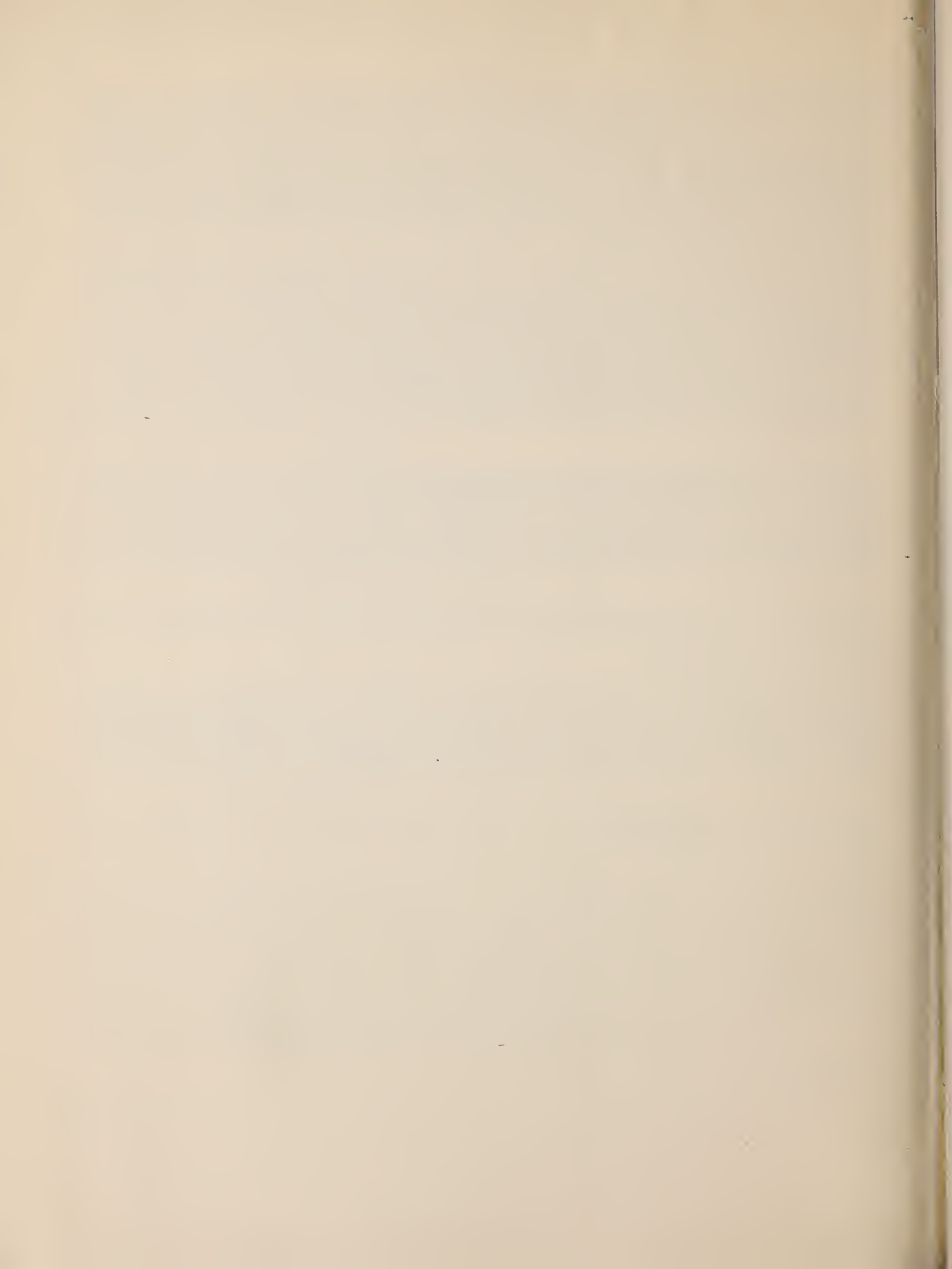
Temperature-regulating valves shall be of the self-contained, self-actuated type with adjustable temperature settings, and direct-acting for throttling control of process heating. Temperatures shall be adjustable from approximately 130 to 190°F. The valves shall be of the double-seated type, and of the proper size to control the flow of steam at the heating rates specified on the drawing. Temperature sensing bulbs shall be of copper, with union connections. Flexible connecting tubings shall be of copper, each approximately 10 feet long.

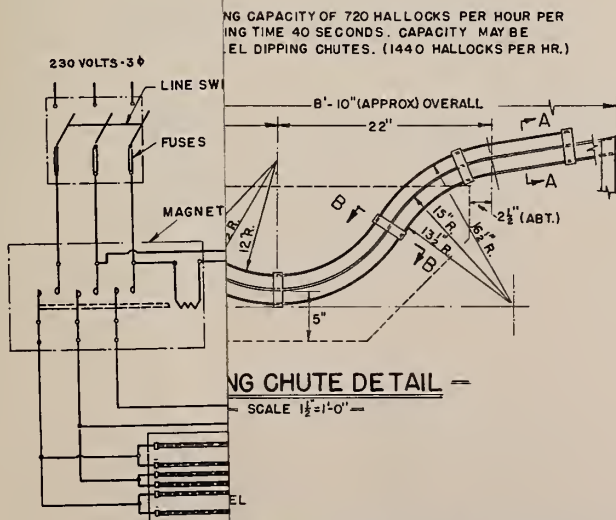
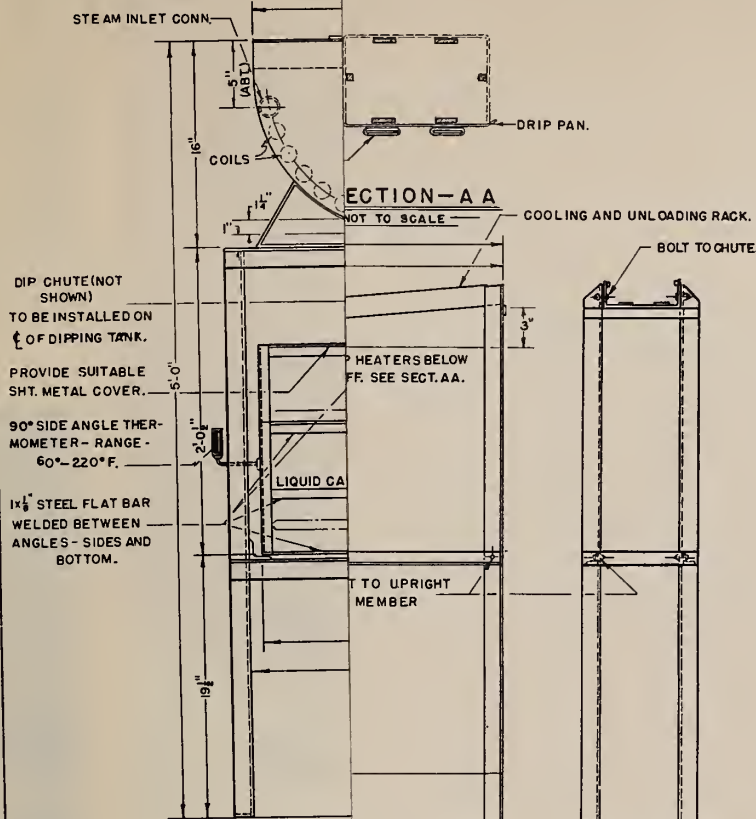
For Electric Heating: Electric immersion heaters shall be of the low-watts density type designed specifically for use in non-circulating paraffin baths. Heaters shall be rated as shown on the drawing and shall be installed in approximately the same positions as the steam-heating coils shown on the drawing. Heaters for the melting tank shall have an immersion length of not more than 28 inches, for the dipping tank not more than 22 inches.

The magnetic contactors shall be of the remote-control type and shall be rated 230 volts, 3-phase, 3-pole, 15-amperes (NEMA Size 0) for both the melting and dipping tank circuits.

Thermostats shall be of the precision type, suitable for immersion mounting. Contacts shall be s.p.s.t., rated at 230 volts, 5 amperes, and shall open on a rise in temperature. Temperatures shall be adjustable over the range of not less than 130 to 190°F., with a minimum differential of not more than 1°F.

All electrical equipment shall be installed in accordance with all local and/or State codes and regulations.





ELECTRICAL

— TYPICAL WIRING — FOR MELTING AND DIPPING
(DIAGRAM FOR MELTING)
(DIAGRAM FOR DIPPING)

**BERRY HALLOCK WAX DIPPING
MACHINE
SINGLE DIP PROCESS**

U. S. DEPARTMENT OF AGRICULTURE
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